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Quasioptical Josephson Oscillator

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13. ABSTRACT (Maximum 200 words)

The Quasioptical Josephson Oscillator (QJO) is a 2-D array of between 100 and 1,000,000 Josephson junctions, each at the center of a small dipole antenna. HYPRES, Inc. of Elmsford, NY has fabricated test chips which have demonstrated 0.35 microwatts radiation at 190 CHz in one case, and 0.7 microwatts radiation at 345 GHz in another case. A significant understanding of the 2-D oscillators was developed through theoretical and numerical calculations.

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Research Objectives and Status

The primary goal of this program was to demonstrate that the Quasioptical Josephson Oscillator (QJO) design is capable of emitting high frequency radiation. This goal has been met with the measurement of 0.36 μ W radiation at 190 GHz from an array of 638 junctions, and with a measurement of 0.7 mW at 345 GHz from an array of 2,784 junctions.

A secondary objective was to understand phase-locking behavior in these arrays. We have accomplished that through extensive numerical and analytical calculations, as well as microwave modeling of the 2-D array structures. The results are an array of different geometry than originally proposed, with the resulting radiation pouring from which proved our analyses correct.

Cumulative list of Refereed Publications (acknowledging this grant, through 4/30/94)

"190 GHz Radiation from a Quasioptical Josephson Junction Array," M. J. Wengler, B. Guan and E. K. Track, *IEEE Transactions on Microwave Theory and Techniques*, submitted.

"Dynamics of Quasioptical Josephson Junction Arrays for Submillimeter Coherent Sources," A. Pance and M. J. Wengler, *IEEE Transactions on Applied Superconductivity*, **3**, pp. 2481-2484, March, 1993.

"Microwave modelling of 2-D active grid antenna arrays," A. Pance and M. J. Wengler, *IEEE Transactions on Microwave Theory and Techniques*, **41**, pp. 20-28, January, 1993.

"Modeling of a quasi-optical Josephson oscillator," B. Liu and M. J. Wengler, *IEEE Trans. Appl. Superconduct.*, **1**, December, 1991, pp. 150-156.

"Quasloptical Josephson oscillator," M. J. Wengler, A. Pance, B. Liu and R. E. Miller, *IEEE Transactions on Magnetics*, **27**, pp. 2708-2711, March, 1991.

Professional Personnel Working on this Grant

Bin Liu, Ph.D. thesis defended July 30, 1993. Thesis title: 2-D Quasi-Optical Josephson Junction Arrays for THz Oscillators.

Aleksandar Pance, Ph.D. thesis defended November 13, 1992. Thesis title: Two-Dimensional Josephson Arrays for Submillimeter Coherent Sources.

Conference Presentations (acknowledging this grant)

"Radiation from a Quasioptical Josephson Junction Array," M. J. Wengler, B. Guan and E. K. Track, *Fifth International Symposium on Space Terahertz Technology*, Ann Arbor, University of Michigan, May, 1994.

"Quasi-Optical 2-D Josephson Junction Array Oscillators with On-Chip Inductive Tuning Structures," B. Liu and M. J. Wengler, *Fourth International Symposium on Space Terahertz Technology*, Los Angeles, pp. 457-473, March 30-April 1, 1993.

"Central Frequency/Wideband Quasioptical Josephson Oscillator Arrays," A. Pance, G. Pance and M. J. Wengler, *Fourth International Symposium on Space Terahertz Technology*, Los Angeles, pp. 477-484, March 30-April 1, 1993.

"Two Dimensional Josephson Junction Array Oscillators," B. Liu, M. J. Wengler and A. W. Lichtenberger, *Seventeenth International Conference on Infrared and Millimeter Waves*, Pasadena, SPIE, pp. 13-14, December 14-17, 1992.

"Parallel Arrays of Josephson Junctions for Submillimeter Local Oscillators," A. Pance and M. J. Wengler, *Third International Symposium on Space Terahertz Technology*, Ann Arbor, University of Michigan, pp. 575-594, March, 1992.

"Submillimeter receiver components using superconducting tunnel junctions," M.J. Wengler, A. Pance, B. Liu, N. Dubash, and G. Pance. in *Superconductivity Applications for Infrared and Microwave Devices II*. Orlando, Florida: SPIE-The International Society for Optical Engineering, vol. 1477, April, 1991.

Interactions (Conferences and Review Panels)

Each of the following was presented by the first author listed:

"Superconducting Electronics for High Performance Circuits," invited for *Wells College Science Seminar Series*, Aurora, New York, November 6, 1991.

"Parallel Arrays of Josephson Junctions for Submillimeter Local Oscillators," A. Pance and M. J. Wengler, *Third International Symposium on Space Terahertz Technology*, Ann Arbor, March 24-26, 1992.

"Modeling of Quasioptical Josephson Oscillator," B. Liu and M. J. Wengler, *International Semiconductor Device Research Symposium*. Charlottesville: Engineering Academic Outreach, University of Virginia, December 4-6, 1991.

"Modeling of Quasioptical Josephson Oscillators," B. Liu and M. J. Wengler, *Fifteenth Annual Electron Devices Activities in Western New York Conference*, Rochester, October 30, 1991.

"Microwave Modelling of Two-Dimensional Planar Antenna Arrays," A. Pance and M. J. Wengler, *PIERS, Progress In Electromagnetics Research Symposium*, Boston, July 1-5, 1991.

"Josephson Junction Grids for Terahertz Oscillators," M. J. Wengler, A. Pance, B. Liu, and R. E. Miller, *SQUID'91*, Berlin, June, 1991.

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